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**MEDICINAL PLANTS USED FOR THE TREATMENT OF TUBERCULOSIS BY BAPEDI
TRADITIONAL HEALERS IN THREE DISTRICTS OF THE LIMPOPO PROVINCE, SOUTH
AFRICA**

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Abstract

The present study was aimed at documenting medicinal plants used for the treatment of tuberculosis (TB) by the Bapedi traditional healers in three districts of the Limpopo Province, South Africa. Fifty two traditional healers from 17 municipalities covering Capricorn, Sekhukhune and Waterberg districts were interviewed between January and July 2011. Twenty one medicinal plant species belonging to 20 genera and 18 families were documented. The majority (61.9%) are indigenous and the rest are exotics, found near homes as weeds or cultivated in home gardens as ornamentals or food plants. Hyacinthaceae, Moraceae and Rutaceae families were the most represented families in terms of species numbers (9.5% each). Herbs and trees (38% each) constituted the largest proportion of the growth forms of the medicinal plants used. Tuberculosis remedies were mostly prepared from leaves (34%) followed by roots (21%). The therapeutic claims made on medicinal plants used to treat TB by the Bapedi traditional healers are well supported by literature, with 71.4% of the species having anti-microbial properties or have similar ethno medicinal uses in other countries. This study therefore, illustrates the importance of medicinal plants in the treatment and management of TB in the Limpopo Province, South Africa.

Keywords: Bapedi traditional healers, ethnobotanical survey, Limpopo Province, South Africa, tuberculosis.

Introduction

According to the World Health Organization (1998), tuberculosis (TB) is an infectious disease caused by the *Mycobacterium tuberculosis*. Gangadharam (1993) noted that *Mycobacterium tuberculosis* mainly affects the lungs, causing lung tuberculosis (pulmonary tuberculosis). However, in some cases other parts of the body may also be affected leading to extrapulmonary tuberculosis (Sharma and Mohan, 2004). Tuberculosis spreads easily in overcrowded settings and in conditions of malnutrition and poverty (Pereira et al., 2005). It is mainly transmitted by exposure to *Tubercle bacilli* in airborne droplets from coughing or sneezing (Narwadiya et al., 2011). The common symptoms of TB are coughing, fever, hemoptysis, chest pain, fatigue and weight loss (Stanhope and Lancaster, 1996). In South Africa, patients with one or more of these signs or symptoms are considered “TB suspect” and must be further investigated for active TB disease according to the national TB guidelines (Department of Health, 2010).

In 1993, the World Health Organization (WHO) declared TB a global emergency because it killed more adults each year than any other infectious disease (The South African Tuberculosis Control Programme, 1998). Approximately one third of the world's population harbours TB infection (Zumla et al., 1999). An estimated 8.3 million new cases and 1.8 million deaths were attributed to this disease in 2000 (Jasmer et al., 2002). Developing countries have much higher incidences of TB than developed countries. A prevalence of 9.2% (Salami and Oluboyo, 2002) and fatality rate of 12% (Salami and Oluboyo, 2003) have been recorded in Nigeria. Mozambique was ranked among the 20 highest TB burden countries in the world, with an estimated 81 000 cases and an incidence rate of 436 per 100 000 people in 2002 (WHO, 2004). In Uganda 402 new cases of TB per 100 000 people were reported in 2005 (WHO, 2007). South Africa was ranked ninth in the list of twenty-two countries that were hardest hit by TB (WHO, 2005). Data from gold mines in South Africa, indicated that the overall TB incidence exceeded 4 000 per 100 000 population per year (Mallory et al., 2000). This incidence is high in the mines largely because of a high prevalence of silica dust exposure (Corbett et al., 2002). Amongst the twenty leading single causes of premature mortality in the North West Province, South Africa, TB was ranked fourth as responsible for death in all genders (Bradshaw et al., 2000); in the Mpumalanga Province, South Africa, TB was ranked sixth as cause of death of persons. Tuberculosis was ranked fifth as the cause of death for all races and both genders in the Limpopo Province, South Africa (Igumbor et al., 2003). Therefore, TB is a serious infectious disease in South Africa, requiring effective strategies and tools to control and manage it.

Tuberculosis control programmes currently emphasize the Directly Observed Treatment Short Course (DOTS) strategy, promoted by the World Health Organization and the International Union against TB and lung disease. South Africa adopted the WHO's DOTS strategy in all nine provinces (Department of Health, 2011). Key tenets of plan are standardized treatment of 68 months for all infectious patients; with directly observed therapy for at least the initial two months (WHO, 2005). However, previous studies by Needham et al. (1998) and Russell (2004) noted that rural patients often delay TB treatment, as they cannot afford to travel to treatment centres (DOTS clinics) daily to have a health worker watch them take their drugs. Kandel et al. (2008) found that of the 255 TB patients who came for treatment at Mbekweni Health Centre in the King Sabata Dalidyebo (KSD) district in the Eastern Cape Province, South Africa, 121 had interrupted their treatment. Reasons for interruption included change of living place, side effects of the drug, lack of knowledge about the treatment

course, physical disability (either too sick or old) to collect treatment, clinic too far and drug not available in the clinic (Kandel et al., 2008). With the rapid increase in infection in sub Saharan Africa and due to the relatively high cost and limited access to synthetically derived drugs, communities in Africa have relied on traditional healers to treat infectious diseases (WHO, 2003). Traditional healers use medicinal plants as their primary source of medicine. Research done in Nigeria by Rinne (2001) revealed that local communities consult traditional healers on a regular basis because they are found within a short distance, are familiar with the patient's culture and the environment and the costs associated with treatments are negligible. Rural patients are also more dependent on traditional or folk medicinal healers for treatment of infectious diseases for a number of reasons, such as lack of access to modern medical facilities and clinging to traditional approaches (Hossan et al., 2010). Despite the increasing acceptance of traditional medicine in treating TB in South Africa (Buwa and Afolayan, 2009; Green et al., 2010), this indigenous knowledge on traditional remedies is not adequately documented. Therefore, the present study investigated and documented the medicinal plants used by the Bapedi traditional healers in the treatment and management of TB in Capricorn, Sekhukhune and Waterberg districts of the Limpopo Province, South Africa.

Materials and methods

The study area

The present study was carried out in 17 local municipalities (Figure 1, Table 1), covering Capricorn, Sekhukhune and Waterberg districts. The majority of people in the study area belong to the Bapedi ethnic group, which is the largest group in the Limpopo Province of South Africa, comprising about 57% of the population (Lodge, 2005).

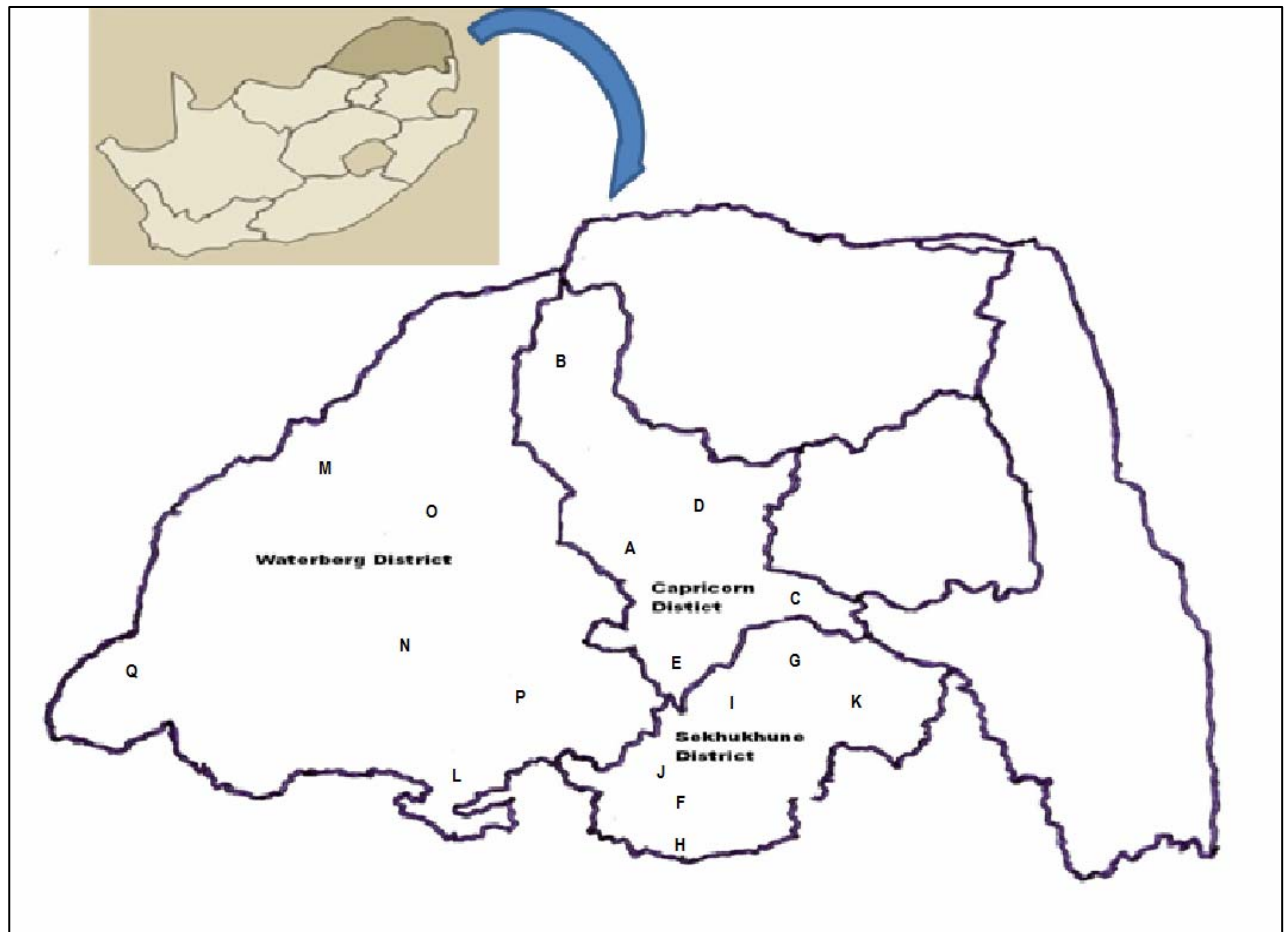


Figure 1: Study area: Capricorn, Waterberg and Sekhukhune districts, Limpopo Province, South Africa. A to Q designates the involved municipalities.

Table 1: Districts and local municipalities in which the study was undertaken

Capricorn district	Sekhukhune district	Waterberg district
Aganang (A)	Alias Motsoaledi (F)	Bela-Bela (L)
Blouberg (B)	Fetakgomo (G)	Lephalale (M)
Lepelle-Nkumpi (C)	Groblersdal (H)	Modimolle (N)
Molemole (D)	Makhuduthamaga (I)	Mogalakwena (O)
Polokwane (E)	Marble Hall (J)	Mookgophong (P)
	Tubatse (K)	Thabazimbi (Q)

Data collection

The study was undertaken between January and July 2011. A total of 52 traditional healers (36 males and 16 females) were purposefully selected with the help of local administrators and elderly people from 17 municipalities within three districts of the Limpopo Province (Table 1, Figure 1). At least two traditional healers per local municipality participated in personal interviews which were conducted in Sepedi language. Verbal informal consent was obtained from each individual traditional healer who participated in the study and researchers adhered to the ethical guidelines of the International Society of Ethnobiology (<http://www.ethnobiology.net>). The aim of the investigation was explained to all participants. Data on plant names, the plant part(s) used, diagnosis of TB, mode of medicinal plant usage and administration were documented. All plant species mentioned by the traditional healers as important in the treatment and management of TB were collected, numbered, pressed and dried for identification. Each specimen included important parts such as leaves, stems, flowers and fruits where available. For small herbaceous plants, the whole plants were collected. Specimens were deposited for future reference at the Larry-Leach Herbarium (UNIN), University of Limpopo.

Results

Medicinal plants used to treat TB

Table 2 gives a list of the plant species used by the Bapedi traditional healers in Capricorn, Sekhukhune and Waterberg districts in the Limpopo Province to treat TB. The survey documented 21 plant species belonging to 20 genera and 18 families (Table 2). Of these, 13 species are indigenous to the Limpopo Province (61.9%), while eight species are exotics (38.1%), either naturalized as weeds or cultivated in home gardens as ornamentals or food plants. Families Hyacinthaceae, Moraceae and Rutaceae are represented by two species each, while the rest of the families are represented by one species each, as shown in Table 2. *Mentha* sp. could not be identified to species level due to non-availability of flowers and fruits at the time of collection. The most regularly used plant species in the study area to treat TB were *Artemisia afra*, cited by 15.4% of the traditional healers; *Eucomis pallidiflora* ssp. *pole-evansii* and *Myrothamnus flabellifolius* (11.5% each), *Lippia javanica* (9.6%) and *Hypoxis hemerocallidea* (7.7%). The other plant species were used either by one or two traditional healers.

Table 2: Plant species used for the treatment of TB in Capricorn, Sekhukhune and Waterberg districts, Limpopo Province, South Africa. An asterisk (*) indicates that the taxon is known or believed to be exotic; and is cultivated in home gardens or naturalized in Limpopo Province, South Africa.

Family, species names, voucher	Habit	Part(s) used	No. of citations in Districts	Capri corn	Sekhu khune	Water berg	Preparation, administration and dosage	Reported uses in literature
Agapathaceae								
<i>Agapanthus inapertus</i> P.Beauv. SS340	Herb	Tuber	—	—	1		Cooked for 10 minutes and one cup of extract is taken orally thrice a day.	None found
Asteraceae								
<i>Artemisia afra</i> Jacq. ex Willd. SS223	Shrub	Leaves	—	—	2		Leaves cooked for 15 minutes and one cup of extract taken orally thrice a day	Asthma, bronchitis, colds, coughs and TB (Van Wyk and Gericke, 2000)
			2	—	—		Leaves crushed, wrapped in newspaper and smoked twice a day or leaves burned in a hut and smoke inhaled twice a day	
			1	1	—		Leaves put in hot water and steam inhaled thrice a day	
			Leaves	2	—	—		

							; roots	with crushed leaves of <i>Mentha</i> spp., wrapped in newspaper and smoked thrice a day	
Cannabaceae									
* <i>Cannabis sativa</i> L. SS24	Herb	Leaves	1	—	—			Leaves macerated in warm water for 24 hours and one cup of decoction taken orally thrice a day	Dry cough (Hutchings et al., 1996)
Caricaceae									
* <i>Carica papaya</i> L. SS70	Tree	Leaves	—	1	—			Leaves burned in a hut and smoke inhaled twice a day	TB (Green et al. 2010)
Combretaceae									
<i>Combretum hereroense</i> Schinz. SS440	Shrub	Bark	—	—	1			Cooked for 20 minutes and one cup of extract taken orally thrice a day	Chest complaints and TB (Watt and Breyer-Brandwijk 1962)
		Seeds	—	1	—			Seeds burned in a hut and smoke inhaled twice a day	
Gentianaceae									
<i>Chironia baccifera</i> L. SS22	Shrub	Roots	—	—	1			Cooked for 20 minutes and one cup of extract taken orally thrice a day	Diarrhoea and leprosy (Van Wyk and Gericke, 2000)
Hyacinthaceae									
<i>Eucomis pallidiflora</i> Baker. ssp. <i>pole-evansii</i> (N.E.Br.) Reyneke SS355	Herb	Bulb	—	—	6			Cooked for 5-8 minutes and one cup of extract taken orally thrice a day	Chest complains, mental-illness and STIs (Moeng 2010)
<i>Merwillia plumbea</i> (Lindl.) Speta SS338	Herb	Bulb	—	—	1			Cooked for 25 minutes and one cup of extract taken orally thrice a day	Constipation, diarrhoea and nausea (Hutchings et al., 1996)
Hypoxidaceae									
<i>Hypoxis hemerocallidea</i> Fisch., C.A.Mey. & Avé-Lall. SS115	Herb	Tuber	2	1	1			Cooked for 5-20 minutes and one cup of extract is taken orally thrice a day	Arthritis, cold, flu, HIV/AIDS and wounds (Grierson and Afolayan, 1999)
Lamiaceae									
<i>Mentha</i> spp. SS477	Herb	Leaves			1			Leaves wrapped and smoked twice a day	None found
Moraceae									
* <i>Ficus carica</i> L. SS89	Tree	Bark	—	—	1			Cooked for 10 minutes and one cup of extract taken orally thrice a day	None found
* <i>Ficus platypoda</i> (Miq.) Miq. SS323	Tree	Roots	1	—				Cooked for 20 minutes and one cup of extract taken orally thrice a day	None found
Myrothamnaceae									
<i>Myrothamnus flabellifolius</i> (Sond.) Welw. SS111	Shrub	Whole plant	2	—				Burned in hut and smoke inhaled four times a day	TB (Watt and Breyer-Brandwijk, 1962)
			2	1	1			Cooked for 5-15 minutes and one cup of extract taken orally thrice a day	
Myrtaceae									
* <i>Eucalyptus camaldulensis</i> Dehnh. SS401	Tree	Leaves ; roots	1	—	1			Cooked for 5-20 minutes and one cup of extract taken orally thrice a day	Asthma, cough, diarrhoea and sore throat (Abubakar, 2010)
Pteridaceae									
<i>Pellaea calomelanos</i> (Sw.) Link SS25	Fern	Roots	—	—	1			Cooked for 15 minutes and one cup of extract taken orally thrice a day	None found
Rosaceae									
* <i>Eriobotrya japonica</i> Lindl. SS311	Tree	Roots	—	—	1			Cooked for 10 minutes and one cup of extract taken orally thrice a day	None found
Rutaceae									
* <i>Citrus lemon</i> (L.) Burm. f. SS480	Tree	Leaves	1	—	1			Crushed leaves, wrapped in newspaper and smoked thrice a day	Cough, flu and fever (Maroyi, 2011)
<i>Zanthoxylum capense</i> (Thunb.) Harv. SS511	Tree	Roots	—	—	1			Burned in a hut and smoke inhaled twice a day	Chronic cough (Bryant, 1966)
			—	—	1			Cooked for 10 minutes and one cup of extract taken orally thrice a day	
Salicaceae									
<i>Salix mucronata</i> Thunb.	Tree	Seeds;	—	—	1			Six raw fruits taken orally thrice a	Fever, rheumatism

SS21		fruits				day	and wound dressing (Eldeen and Van Staden, 2007)
		–	1	–		Fruits and seeds ground into powder and five table spoons taken orally with warm water thrice a day	
Verbenaceae							
<i>Lippia javanica</i> (Burm. f.) Spreng. SS180	Herb	Leaves	–	1	2	Cooked for 5 minutes and one cup of extract taken orally thrice a day	Respiratory complaints (Watt and Breyer-Brandwijk, 1962); TB (Green et al., 2010)
			–	–	2	Leaves put in hot water and steam inhaled thrice a day	
Zingiberaceae							
* <i>Aframomum melegueta</i> (Rox.) K.Schum. SS331	Herb	Roots	–	–	1	Cooked for 10 minutes and one cup of extract is taken orally thrice a day	Chest congestion, cough and TB (Betti, 2004; Gill, 1992)

Diagnosis

Bapedi traditional healers diagnosed TB based on patient's signs and symptoms. Before starting the treatment, patients were observed carefully and asked about the signs and symptoms of TB (Table 3). The Bapedi traditional healers assess the treatment outcomes in patients, mainly by patient feedback and disappearance of TB signs and symptoms. Any patient who presented one or a combination of the signs and symptoms given in Table 3 was considered by the Bapedi traditional healers as TB "suspect". Blood in the sputum was the most commonly cited diagnostic criterion, followed by a prolonged cough. After diagnosis, the healers prescribed and prepared the medication.

Table 3: Criteria used by the Bapedi traditional healers to diagnose TB

Signs and symptoms	No. of traditional healers*
Blood in the sputum	19
Prolonged cough	14
Weight loss	4
Swelled face and blood in the sputum	2
Chest pain and breathlessness	1

*Some traditional healers provided more than one diagnostic criterion

Growth forms, plant parts used and methods of application

An analysis of the medicinal species used by the Bapedi traditional healers to treat TB, revealed that herbs and trees constituted the largest proportion of growth forms with 38% each, followed by shrubs with 19% as shown in Figure 2A. Pteridophytes were represented by a single fern species, *Pellaea calomelanos* (Table 2). The plant parts used for herbal preparations were the roots, bulbs, tubers, leaves, bark, seeds, and fruits. The leaves were the most commonly used (34%), followed by roots (21%), whole plant (11%), bulbs and tubers (9% each), fruits (7%), bark and seeds with 4.5% each (Figure 2B). The whole plant was administered for herbaceous plant species. 28 TB remedies (96.6%) were prepared from single species (Table 2). However, crushed leaves and roots of *Artemisia afra* were mixed with crushed leaves of *Mentha* spp. and smoked thrice a day. Methods of herbal administration included oral, smoking and inhalation. Extracts or decoctions were prescribed orally with a metal cup (250 ml). The fruits of *Salix mucronata* were taken orally as raw thrice a day (Table 2). Traditional healers also burnt leaves of *Artemisia afra*, *Carica papaya* (leaves), *Combretum hereroense* (seeds), *Myrothamnus flabellifolius* (whole plant) and roots of *Zanthoxylum capense* in the consultation hut and patients inhaled the smoke twice to four times a day (Table 2). Leaves of *Artemisia afra* and *Lippia javanica* were deposited in a basin full of hot water and patients inhaled the resultant steam with their heads covered with a blanket. Crushed leaves of *Artemisia afra*, *Citrus lemon* and *Mentha* sp. were wrapped in a newspaper and smoked twice or thrice a day. All herbal preparations were taken for two weeks to a month depending on patient's response to the medication, and individual healer's experience with TB treatment and management.

Discussion

A large proportion of the plant species documented in this study have been validated through phytochemical and pharmaceutical research. Some, though not evaluated for their efficacy are used to treat TB and related diseases in South Africa and other parts of the world. For example *Lippia javanica* and *Carica papaya* are used by the VhaVenda traditional healers of the Limpopo Province, South Africa to treat TB (Green et al., 2010). Leaves of *Lippia javanica* are used extensively in southern Africa to treat respiratory complaints (Watt and Breyer-Brandwijk, 1962). Likewise, *Cannabis sativa* leaves are smoked by Zulu people to treat dry cough (Hutchings et al., 1996), while the root of *Zanthoxylum capense* is a remedy for chronic coughs (Bryant, 1966). Similarly, *Aframomum melegueta* is documented as a remedy for tuberculosis,

cough and chest congestion in Cameroon (Betti, 2004) and Nigeria (Gill, 1992). Eldeen and Van Staden (2007) documented anti-bacterial activity of *Salix mucronata*. Leaf extract of *Eucalyptus camaldulensis* inhibited the growth of *Bacillus cereus*, *Escherichia coli*, *Klebsiella pneumonia* and *Staphylococcus aureus* (Abubakar, 2010). *Combretum hereroense* is reported as a remedy for TB and chest complaints in southern and eastern Africa (Watt and Breyer-Brandwijk, 1962). Extracts from this

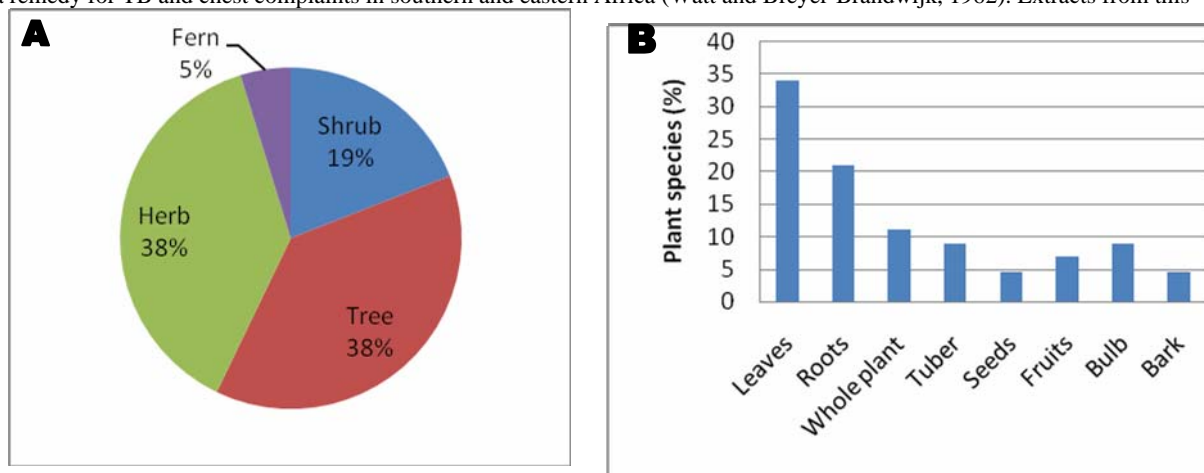


Figure 2: Characteristics of the plants used for the treatment and management of TB in the Limpopo Province. A. Growth habit represented in pie diagram and (B) plant part(s) used represented in bar chart.

species have shown some activity against *Bacillus cereus*, *Escherichia coli*, *Klebsiella pneumonia* and *Staphylococcus aureus* (Alexander et al., 1992). To the best of our knowledge *Eriobotrya japonica* and *Merwillia plumbea* are reported in this study for the first time as remedies for TB in South Africa; but they are widely used to treat an array of other ailments including boils, impotency, infertility, sores and wounds (Van Wyk et al., 2009). Furthermore, the use of *Eriobotrya japonica* by the Bapedi traditional healers as TB remedy is consistent with its application in Chinese ethno medicine (Parihar et al., 2011). The people of Muroto and Susaki cities in Japan (Nishioka et al., 2002) and traditional healers in Korea (Ito et al., 2000), use this species as a remedy for cough, an ailment either directly or indirectly associated with TB (Zaman et al., 2006). Although no known reports exist for *Merwillia plumbea* as a TB remedy in South Africa, its bulb extract demonstrated anti-bacterial activity against *Staphylococcus aureus* (Verschaeve and Van Staden, 2008).

The wide utilization of *Artemisia afra* by the Bapedi traditional healers in this study to treat TB is in partial agreement with findings of Van Wyk and Gericke (2000), who noted its use as a remedy for respiratory disorders (asthma, bronchitis, colds, coughs and whooping cough). Leaf extract of *Artemisia afra* has been reported by Buwa and Afolayan (2009) as active against *Bacillus cereus*, *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumonia*, and *Mycobacterium A+* strain. No anti-bacterial activity has been documented so far for *Eucomis pallidiflora* ssp. *pole-evansii*, a widely used TB remedy in the Limpopo Province. But anti-bacterial activity against *Staphylococcus aureus* have been demonstrated by two closely related *Eucomis comosa* and *Eucomis humilis* (Du Toit et al., 2005). A study by Grierson and Afolayan (1999) noted wide use of *Hypoxis hemerocallidea* by Xhosa healers to treat wounds and alleviate arthritis, cold, flu and HIV/AIDS. According to Lall and Meyer (2001), individuals infected with HIV/AIDS are also susceptible to TB and often develop this disease before other manifestations become apparent. Pharmacological activities of *Hypoxis hemerocallidea* extracts have been documented by Nicoletti et al. (1992), Mills et al. (2005), Ojewole (2006) and Muwanga (2006). The uses of *Myrothamnus flabellifolius* as a TB remedy and other related ailments are well documented in South Africa (Watt and Breyer-Brandwijk, 1962; Mabogo, 1990; Hutchings et al., 1996) and Zimbabwe (Gelfand et al., 1985).

Conclusion

This study shows that local communities in the Limpopo Province are still dependant on traditional medicines to treat and manage TB. The documented medicinal plants used by the Bapedi traditional healers reflect a rich ethno medicinal knowledge in the province. These results strengthen the firm belief that traditional medicines are readily accessible and still play an important role in meeting the basic health care of many people in developing countries. Some of the medicinal plants documented in this study can provide a treatment option that is readily accessible and affordable to TB patients in the Limpopo Province, the rest of South Africa and also beyond the national boundaries. The literature search has also shown that a large proportion of medicinal plants prescribed to TB patients by the Bapedi traditional healers are effective against several infectious pathogens. This is an indication of the potential value of the documented medicinal plants as sources of compounds needed for the development of plant derived anti-tuberculosis drugs.

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